Developing a Service Innovation Utilizing Remotely Piloted Aircraft System (RPAS)

Ilkka Tikanmäki, Tuomo Tuohimaa and Harri Ruoslahti

Abstract—Co-operation between authorities is at the beginning of new challenges. When authorities co-operate successfully, this prevents duplication of efforts and increases efficiency. Many public authorities have at the moment and in the future same needs for equipment and systems. Operational and command centers of authorities (for example, police and rescue service), have potential needs to improve continually their situational awareness and a real time picture.

Related research and development (R&D) in public and private sector has an important role already today. Research and development is in a key position at first step. The importance of safety is the key element when operating on the air. A well planned system takes notice of the end user and is made in co-operation with the equipment manufacturers and end-users. One of the main challenges is to accompany manufacturers and end-users.

Public and private co-operation is needed and it must be increased. Legislation must be in line both with the international and national levels. Legislation does not sufficiently or even at all detect the UAS activity. Developing this kind of service innovation is in an important and challenging role for three reasons; 1) various actors need to be able to meet the demand of the right way, 2) it must give a special attention for many different needs, and 3) because of the inadequate aerial legislation as for unmanned aviation.

Keywords— Legislation, public, private, unmanned aircraft system, unmanned aerial vehicle, service provider, service innovation

I. Introduction

This paper converses on designing new applications and services in the field of Remotely Piloted Aircraft (RPA) and objectives to make a service innovation with RPA systems. Prior studies have revealed a need for networking between different authorities with regard to cooperation of implementation of Unmanned Aircraft System (UAS).

Utilizing UAS for routine missions has several obstacles; 1) the aviation laws do not recognize UAS, so there is not sufficient guidance for the use of UAS, 2) UAS is a relatively new "phenomenon", so the potential it generates is not yet been understood, 3) governmental cooperation environment is not sufficiently innovative and forward looking, cooperation should always and in all circumstances be possible and 4) the limited resources of public organizations restrict the introduction of new concepts [1].

Non-military UAS applications are divided into five categories: security (39 sub-categories), safety (35 sub-categories) and scientific & research related applications (31 sub-categories) and contractor supplied flight services (38 sub-categories) as well as civil/military cooperation (34 sub-categories). Civil/military cooperation is also known as 'mutualisation'.

Table 1 shows number of current applications which can be operated by UAS.

TABLE 1 CURRENT UAS APPLICATIONS AND QUANTITY IN EU [2]

	MTOM< 150 kg			MTOM > 150 kg		
	VLOS	BLOS	Total	VLOS	BLOS	Total
Security related	6	8	14	5	6	11
Safety related	6	1	7	1	1	2
Scientific & Research related	14	2	16	1	1	2
Contractor Supplied Flight Services	25	4	29	1	1	2
Civil/Military Cooperation	1	0	1	0	5	5

BLOS= Beyond Line-of-Sight, VLOS= Visual Line-of-Sight, MTOM= Maximum take-off mass

The European Commission allocates UAS into two categories according to their weight: maximum take-off mass (MTOM) below 150 kg and MTOM above 150 kg. UAS' usage is growing in Europe with regard to different security, safety and scientific & research related missions as well as contractor supplied flight services and civil/military cooperation.

With regard to UAS-systems utilization, Finnish aerospace and aviation technology professionals' visions and objectives are to create the ability to develop and maintain these systems. Also, a profitable international business potential is seen. Co-operating intensity is depending on an interaction between private sector strategies and public sector policies and

Manuscript received May 19, 2012.

I. Tikanmäki, T. Tuohimaa and H. Ruoslahti are with Laurea University of Applied Sciences, Vanha Maantie 9, FI-02650 Espoo, Finland (phone: +358-9-8868 7400; e-mail: ilkka.tikanmaki@laurea.fi, tuomo.tuohimaa@laurea.fi, harri.ruoslahti@laurea.fi).

institutions. The public and private sectors together promote a favourable environment for this matter [3].

Estimates of the forecasted market are done by comparing results and conclusions from several sources. Potential UAS applications are base on the assumption that the regulatory problems are solved.

Table 2 presents the summary of UAS related projected applications in EU.

TABLE 2 OVERVIEW OF PROJECTED UAS APPLICATIONS IN EU [2]

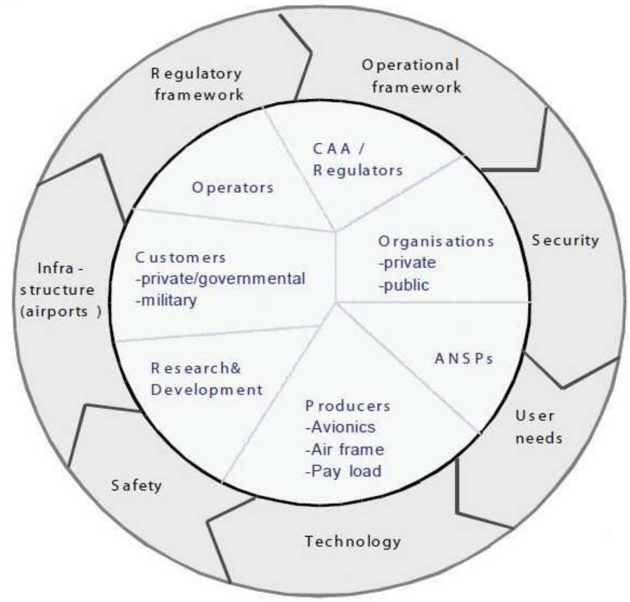
	MTOM< 150 kg			MTOM > 150 kg		
	VLOS	BLOS	Total	VLOS	BLOS	Total
Security related	23	26	49	5	27	33
Safety related	30	27	57	2	29	31
Scientific & Research related	20	20	40	0	21	21
Contractor Supplied Flight Services	35	15	45	0	13	13
Civil/Military Cooperation	1	24	25	0	33	33

European Commissions' (EC) Seventh Framework Program for Research and Technological Development (FP7) includes several UAS projects; Airborne Information for Emergency Situation Awareness and Monitoring (AIRBEAM) being one of them. AIRBEAM proposes a situational awareness toolbox for crisis management over a wide area applying UAVs, UAS and satellite systems. Many UAVs and space-based platforms are available.

These system-related sensors pose new challenges for end-users with an effective emergency management and law enforcement to maintain. AIRBEAM's aim is to provide all authority organisations in each EU Member State to define their own needs and evaluate technical solutions that should be offered by unmanned aerial platforms. AIRBEAM's ambitious goal is to establish close cooperation between industry partners, stakeholders and end users with a realistic workable concept [4].

As Fig. 1 shows, there are several considerations affecting the integration of UAS into a non-segregated airspace. However, main issue will be integration of UAS to Air Traffic Management (ATM) System. Non-adapted legal framework limits UAS potential [2].

FIGURE 1 THE UAS STAKEHOLDER FRAMEWORK [5]



The Innovative Operational UAS Integration (INOUI) project is a part of the European Commission Research Program FP6, Directorate-General for Energy and Transport (DG Tren). INOUI contributes the project results into the Single European Sky ATM Research (SESAR) Development Phase. The goal is to enable the earliest possible use of UAS applications in current and future ATM environment [5].

Deficiencies of the law and regulatory measures prevent the industry from building business plans and launching the developments required to answer civil customer needs. This has also a negative impact on the industry and, indirectly, on UAS manufacturers, end users, research institutions and R & D companies. The impact is particularly apparent in Small and Medium sized Enterprises (SME's) and Small and Medium Industries (SMI's) [6].

A. *Structuring of the rest paper*

This paper is structured as follows: Chapter II Problem Formulation discusses the theoretical background, and is divided to sub-sections theoretical framework, research method and process and empirical context and target. Chapter III presents developing service innovation with RPAS, and has sub-sections; strategy, scenario, vision, core competence, customers and network partners, and field of activity. Finally, Chapter IV sets out the discussions and conclusions of the study.

II. Problem Formulation

A. *Theoretical Framework*

The importance of cooperation between authorities discovers an important subject to be developed. Finnish Government's Security and Defence Policy state that close cooperation between the authorities create cluster synergy effects by cutting overlapping functions and support functions, thus enabling an efficient use of resources [7].

Prior studies reveal a need for networking between the authorities with regard to the cooperation of implementation of UAS [8]. Networking benefits of government activities are emphasized, because the authorities do not need a duplication of resources. None of the authority is solely responsible for certain activities, because there is an exemplary cooperation between public authorities. The authority who is responsible for operation receives support from other authorities.

The importance of cooperation in UAS usage is highlighted because a number of different actors, such as police, rescue service, customs and border control authorities need the same kind of services. The service provider must be familiar with the various actors' needs to be able to meet the demand in the right way. Selecting a product for many different needs of operators must therefore give special attention.

Interagency cooperation is essential that various actors have sufficient knowledge of other's concepts, measures, resources and plans. Interagency co-operation aims at cost savings to increase efficiency. Good collaborative practices are a prerequisite for proper functioning [8]. Networking is a process where the corporate knowledge, values and skills combine the added value of productive activity, aiming at the promotion of competitiveness in the longer term [9].

Different levels of networking means that cooperation between organizations is needed; performing a similar task teams to cooperate, or individual experts formed a collaborative network. UAS-cooperation with the authorities will act in all of the above mentioned areas.

For example, large public events have temporary command centers for general and field management, where liaison officers of different actors allow coordination of actions. Command centers usually have representatives from the police, the event organizer, rescue services, border guards, customs and military. Depending of the nature of the event design and operation there may also be other public authorities [8].

Basis of the above, for example, the police command centers' main tasks in Finland are to support police management functions, situational awareness and real time picture, maintaining the pre-trial measures, external and internal information, and support services. Tasks include also working in collaboration with emergency response centers and other authorities' command centers. Cooperating is challenging and leadership rises to the very important role when operating with different authorities' operations.

With regard to the development of UAS services, networking is very important, especially for a small country with limited resources. One player is unable to cope on its own for systems implementation and use of it. That is why network creation is vitally important and obtains synergies from a wide-scale deployment of the UAS.

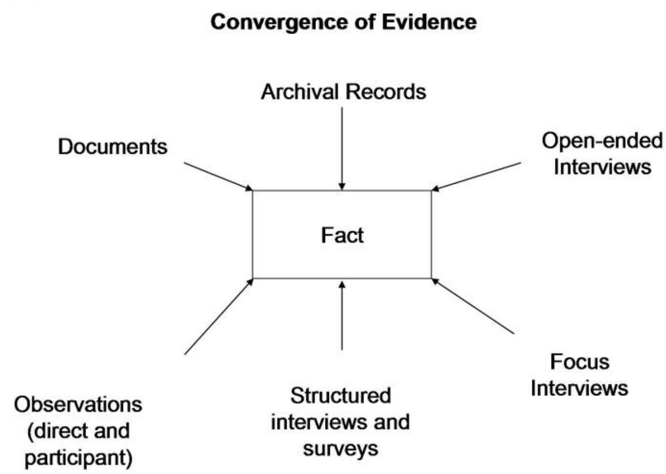
B. Research Method and process

This case study research finds out how services can be produced by applying Unmanned Aircraft Systems and what legal obstacles there are when using UAS in public organizations. The study has attempted to generate a new theory on the basis of existing theoretical constructs to meet organizational needs. As noted in the literature review, this study's specific research aim is a relatively new one.

Therefore, our research approach is a case study that is generally recommended for theory-building [10], [11]. The researchers should understand the implications of their research perspective, and act in ways that reflect that knowledge [12]. Authors of this paper have a long experience in different organizations, where the needs of UAS can be utilized.

In a case study, the usage of a variety of sources is recommended, including interviews and written materials [13], [14]. The evidence collection phase contains many different modes and methods. None of them is unique to a case study and techniques differ greatly [14]. According to [10], case study research may utilize a variety of data-collection methods, such as can be seen from Fig. 2.

FIGURE 2 CONVERGENCE OF MULTIPLE SOURCES OF EVIDENCE [10]



The material collected for this study is based on interviews, international and national aviation regulations, scientific publications, collected articles and literary material. One prominent data collecting method used was focus interviews. The focus interviewees were designated based on their expertise on aviation laws and aviation industry. The interviewees operate in the preparation of aerial legislation as training providers or service providers. This case study uses triangulation of data sources to ensure the credibility and validity of the results

Analysing case study data is the heart of theory building. At the same time, it is the most difficult and the least codified part of the process [11]. The focus of the analysis is the obstacles in the current legislation with regard to UAS. National Aviation Acts differ widely from each other; hence we focus on preparation of international aviation laws. Case study researchers should pay attention to three areas; design issues, data collection and data analysis [15], [16]. During the research process, we paid special attention to above-mentioned points.

C. Empirical context and target

The biggest challenge for operational use of UAVs is that legislation does not recognise well enough UAV as an aircraft. Training and other requirements are not specified for UAS-operations. Especially, the development of large UAVs is waiting for standardization.

Main obstacles for Light (small) UAS (25 - 150 kg) are varying national certification standards and rules. Norway and UK have basic standards and rules, Czech Republic, the Netherlands and France have nearly ready rules which, however, are not harmonized in European level. 'Sense and avoid' binding funded research is not ongoing or upcoming at the moment [2].

International Civil Aviation Organization (ICAO) has defined 'a pilotless aircraft flight at airspace' as follows [17]: "No aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a contracting State without special authorization by that State and in accordance with the terms of such authorization. Each contracting State undertakes to insure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft".

ICAO has also defined 'non-segregated' and 'segregated' airspaces. Non-segregated airspace means "airspace where all traffic, including civil traffic is authorised to fly and where both manned and unmanned traffic will be integrated according to established procedures". Segregated airspace means "airspace that is segregated for exclusive use and into which other traffic is not permitted." [17]

An Unmanned Aircraft Systems Study Group (UASSG) state in their Training Course of Regional Officers on November 2009 that UASSG is the focal point to all issues concerning UAS's within ICAO. In order to prevent UAS issues they should assist the Secretariat in coordinating the development of ICAO Standards and Recommended Practices (SARPS), procedures and guidance material for civil unmanned aircraft systems (UAS), to support a safe, secure and efficient integration of UAS into non-segregated airspace and aerodromes [18].

Currently, most military UAV operations in Europe are restricted to run only in the reserved airspace, where UAVs' flying area is separate from other air traffic, or UAVs are flying above the sea, applying special arrangements. If action takes place outside the segregated airspace, there will be various constraints in order to protect other aircrafts using the same airspace [17].

To take full advantage of current and future UAV platforms' capabilities, a training program has to accomplish the safe UAV operations. Military authorities in Europe insist that UAVs can be used in all classes of airspace. Also, they should operate across national borders. This means that UAVs should be used outside of segregated airspace. Furthermore, national level regulations are not conducive to routine operations.

In addition, taking into account the obvious interest, and a lack of similar in the rest of the world, non-European countries could decide to accept the specifications. Specifications may provide a basis for future Air Traffic Management (ATM) for civil UAVs. Aspects outside the jurisdiction of Eurocontrol must be dealt with appropriate bodies. These aspects are e.g. airworthiness, certification, system safety, training and licensing of personnel.

If we look at training from economical point of view, even though UAV is flying in non-segregated airspace, the pilot-in-command does not need to be a classified crew member. The pilot-in-command is required adequate training so that he/she can interact with Air Traffic Control (ATC) and other airspace users. For example, IFR flight requires an instrument flight rating.

Training costs are less expensive than manned aircraft's pilots, but more than the basic requirements for UAV operators. As the specifications require, the air traffic services provided to UAVs should be equal to manned aircraft. Hence, only the controllers would need additional training, primarily in emergency situations, which are unique to UAVs. Air traffic controllers need to familiarize with UAV performance insofar as it relates to control in the rest of the traffic integration. The cost of controller training would be relatively insignificant.

To implement ATM integration of UAS operations, UAS needs: 1) to respond to and communicate with ATC, 2) to navigate, and to monitor air space and air to operate, 3) to sense and avoid collisions, and 4) predict the actions for ATC and pilots. Integration of airworthiness certification requires certification for unmanned aircraft, control station and the command and control links. Operator's certification has to be same as for manned aircraft and operator's documentation has to include manuals and charts. The pilot in charge has to be a licensed pilot [18].

ICAO's ongoing UAS-related tasks are

- to analyze the issues of existing Standard and Recommended Practice (SARPs),
- determine the gaps of unmanned aviation and to explore solutions developed by the individual countries/regions,
- participation to essential panels, workgroups/study groups and Secretariat to modify an existing SARPS which have unique features to UAS.

Conclusions from the Study Group were the basis for the development of SARPS, Procedures for Air Navigation Services (PANS) and development of guidance material. The working group decisions are also a holistic approach to UAS relevant, the partner countries and industry associations and technical specifications performing bodies and multi-year commitment to UAS-tested social matters [18].

The Study Group's development concepts in terminology are; RPA + Remote-controlled Pilot Station + Command and Control links (C2) form the RPAS. According to [19x], RPAS evolved concepts are; a) RPAS is a part UAS, b) RPA requires a registration and Certification of Airworthless (CofA), c) CofA considers the whole system, d) State of RPA design includes a remote pilot station type certificate data sheets, e)

Remote pilot station's state monitoring is essential, f) Defining Quality of Service (QoS) and Required Communications Performance (RPC) for Command and Control links, and g) UAS operator's certificate details must be accurate.

Licensing of the remote pilot is one of the pending issues according to [19]. Should remote pilot licensing qualify by type of the RPA or by remote pilot station? License should anyhow specify both the type of RPA and the remotely piloted station. Remote piloting, in any case, requires new arrangements [19].

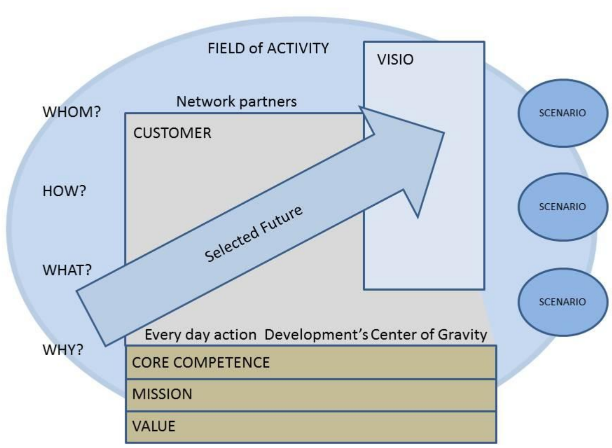
Chicago Convention Article 32 determines Licenses of personnel; Convention incorporates 'pilot' and 'other members of the operating crew' but not the remote pilot [20]. CAP 722 guidance gives criteria as airworthiness, determinations to flying devices, for risk assessment during the flight as well as the flight safety determinations. Instructions can be used to control the UAS systems safety use comprehensive [21].

In the point of view of technology's economic estimate, the economic challenges are the development and dissemination costs. Even if there is some R & D funding, most of the industrial R & D expenses will be directed to UAS operators. Sense and avoid is likely to be highly significant cost factor. Progressing technology extends to all the parts of the UA system, both in the air and on the ground. Data-linking and related needs for the spectrum are other aspects that pose a significant cost, even though it is impossible to estimate how much [17].

III. DEVELOPING A SERVICE INNOVATION WITH RPAS

The strategy is a living, dynamic, comprehensive and progressive tool of the future for the management, managers, and for the entire organization to ensure realization of the vision [22]. As we can see from Fig. 3 below, strategic basis consists of values, mission and core competences.

FIGURE 3 EVERY DAY STRATEGY [22]



The following sub-chapters explain the developing process in service innovation.

A. Strategy

Conceptualization of the future begins by working through the scenario, which outlines the probable, imminent, and a desirable future for five or ten years from now. Vision shall be drawn up by using the scenarios, and it is an image or story of the desired future [22].

Activities in the field response to the question: in what activities we are involved with? Customers can be defined by answering the question: For whom we are here now and in the future? The network partners can be defined by answering the question: For whom the vision is a reality and will it come true? [22].

Future management is based on the conclusion that the future can be created. All, what you do affect in the future. The future can be created and it can be influenced by own efforts, the future can be made, and action requires the organization to a proactive approach [23.

Public organizations have traditionally alienated this approach, especially independent strategic flexibility and individual responsibility for its creation and exploitation. Strategy is an essential part of the future. Public organizations should continuously evaluate their strategic position and it should be a natural part of normal activity [23].

B. Scenario

The future is not ready, but it will arise through today's decisions and activities. Scenario work is already part of creating strategy. When reforming the company's strategy you must look at the top and gaze to the forward. Examination of the future is based on alternative futures, scenarios, and conceptualization [22].

Conceptualization of scenarios provides the basis for the defining for selected future, a vision. At the same time you will also think matters you have not reflected for the future – also unwanted future [22].

Many different authorities are at the present and especially in the future in a common need of equipment and different systems. Operational and command centers of different authorities (for example, police and rescue services), have potential needs to improve their situational awareness and real time picture.

C. Vision

The driving force of strategy is the vision, because it shows the desired state of affairs in the future. Vision must describe what the organization wants to be in a certain moment in the future. Vision answers the question: "Where do we head?" Vision formulation is based on the scenarios, on the basis you select a future, in which you want to go. A good vision is also in-depth for a network partner in a partnership [22].

It should be remembered that UA systems are originally developed for military forces' needs. Now the time has come to use these systems for various civil applications. Related research and development (R&D) is in a very important role in the future and already today. ICAO's role has been very successful in air traffic legislation. The importance of safety is the key element of operating, which in practice means a license scheme for the systems.

Sharing of the situational picture has challenges. These challenges include the variation of allocation tools, concepts and interfaces in different organizations. Common terminology and concepts are missing, both nationally and internationally, as well as practices that co-operation methods vary greatly between countries. Information produced by various sensors for combination treatment and follow-up measures, and decision support is missing. Communication interfaces must be standardized such a way that a situational picture can be transmitted to the various organizations [24].

The challenges for the situational picture are; identification of action and needs, different users, machine and human interaction, distribution of information, safety requirements, reliability requirements, complex systems, lots of information, support for decision making and integration requirements. Research is only a part of the answer to the challenges outlined above [24].

Development requires international cooperation (EU, UN, NATO, the Nordic countries, Baltic countries). Real-time requirements are growing, development will require international cooperation, and situational awareness is a wide-ranging. Situational picture is formed by the sensor data through data fusion. However, this specific research area is fragmented [24].

D. *Core competence*

When you are creating a strategy, it is essential to consider with what kind of expertise we can implement realizing our vision. To identify the core competence you must answer to the following question:

What can we do, which:

1. is unique
2. adds more value to our customers
3. creates new possibilities in the future [22].

The identification of the core competence has proven to be one of the most challenging tasks in reforming strategies. Frequently, the core competencies reflection is limited only with a knowledge in which a company or organization has been established. Core expertise consists only through the knowledge of individuals [22].

Legislation does not sufficiently, or even at all, detect RPAS activity. The whole operation and the meaning of commercialization are not understood, and it seems to be blurred. Co-operation between different authorities is just in the beginning. In addition, only a limited number of civil organizations prevent the development of new RPAS services and the EU legislation differs from national legislation. The purpose and challenge of the AIRBEAM project is to bring together manufacturers and end users. Co-operation and working together prevents duplication of efforts and increases efficiency. However, some kind of co-operation already exists and is under development.

E. *Customers and network partners*

Central part of strategy is to find the answer to the question: "Who do we exist for?" The goal is to understand our customers' current and future needs and to seek continuous improvement. A customer's role in the development of new products and service development is emerging more and more important part. Customer may also be a partner in the creation and operation of the development. The boundary between the network partners is interlaced [22].

The network partners are the key organizations, which we need to implement the strategy, in which are not listed all stakeholders and partners, but to identify the critical partnerships. At its best, the partnership takes place when both parties are feeling that they are getting benefits of the cooperation. It is good to view the network partners from the core competence perspective: whether these partners have such know-how that supports the strengthening of core competencies [22].

The rapid development and continuous renewal of organizations require new skills; organizations must be learning ones. In the private sector, the learning organization ideology-related changes have occurred quickly. On the other hand; the public sector changes will require time. Public organizations have been accused inconvenient, bureaucratic and inflexible to be ineffective, costly and fragile for providing services [25]. The reason for this is the administrative machinery and rigid practices.

Public services have been carried out by highlighting the effectiveness, economic thinking and the customer's responsibility. Public organizations need an entirely new approach and working culture. Skills are increasingly complex and require continuous learning, skills and qualifications of maintenance and development [25]. End users, developers, and potential entrepreneurs who develop business plans for UAS services must work together to attract investors and customers [26].

Cooperation between the public and the private sector for using RPAS need strengthening since services are needed widely. Common service providers in the use of RPAS to the needs of public administration should seriously consider because of the economic and practical reasons. Challenge for cooperation in this particular case is to reconcile the needs of different actors - both in public and private - under common interests.

F. *Field of activity*

The field of activity constitutes the theoretical framework for the strategy and it impacts on all other strategic choices. The main question regarding the definition in the field of activity is, "In what activities are we involved with and who are our competitors?" A part from the knowledge of the operating environment is the current and future competitive environment analysis. However, a unique competitive advantage can be achieved only through our own action [22].

The operational definition of the field also projects, with who we must work together. Our selection shows, what skills we need to strengthen. Determining the field of action is a strategic choice, which will strengthen the vision. The field of activity is appropriate to consider through the operating environment and the future. The field of activity is chosen as a part of the wider operating environment, and it should also be viewed from three perspectives:

- the individual
- the organization
- society [22].

From the point of view of the customer, the field of activity is monitored through customers' and end-users' eyes. The key questions are; how does the known future (such as technological evolution) change, and still uncertain details of the future changes affect to our customers / end-user behavior and how this is reflected in the chosen field of activity [22x].

When assessing the activity levels of the organization, it is estimated what kind of changes are expected in the activities of our organization. The main question is: what kind of organization is the most successful in the field of activity? [22].

The third aspect is the level of society. How will these possible factors mentioned above, and the chosen future, affect to actors of society and with whom should we collaborate? [22].

Definition of the field of action is an important part of the organization's renewal. It involves a change of resistance, fear and uncertainty about the future. Definition of the field of activity always includes a risk that you adhere in the old mode of operation. Another risk is that the field of activity will be skipped too quickly without considering more details. For example; how the definition affects other parts of strategy and the same time the entire operation? [22].

RPAS can be used in the Public Sector for different kinds of purposes. Security in mass events like football games and demonstrations could be improved by using RPA. Operational management, situational awareness and security in public events are enhanced by using RPA [23].

Developing Remotely Piloted Aircraft Systems presents big challenges both to the designer and for the end user. New and novel technologies must be developed, tested and implemented for actual missions. Research and development activities must be improved especially between designer and end user [27]. Scientific and technological development in wireless communications, sensor technology, sensors, and in other regions has quickly made it possible to research and develop unmanned aerial systems for different applications [28].

IV. DISCUSSION AND CONCLUSIONS

The starting point of this study was to find out how services can be produced by using Unmanned Aircraft Systems and what obstacles are there in the operational point of view. The research was started by a desire to explore is it possible and how it can be done by using RPAS. The theoretical part focused on theory building of case study research and how it can exploit in this study.

The scientific publications concentrate on the building, planning and on the technical properties of RPAS. Remotely piloted aircrafts are currently used mainly for various military purposes. This study is limited to civilian use of RPAS, which is restricted by the various lacks in legislation. RPAS could be used for many different purposes in both government and civilian activities.

The aim of this research was to analyze and assemble a clear summary about developing a service innovation utilizing RPAS by using different kind of data. The study also succeeded to clarify the implications for different organisations when RPAS is used in the future. Research objectives were successfully reached and the research questions were answered. This study shows the needs for RPAS but also a social general ignorance on how RPAS can exploited in civilian use.

Recent advances have allowed future RPAS users to scale down sizes of uninhabited aerial platforms, and to perform mission profiles which are not possible for conventional aircraft. One advantage of UAV is the possibility to reach hostile and inaccessible areas without exposing humans to hazards and dangerous situations [29].

The best results may be achieved by identifying the various authorities' possibilities and methods. When drawing up a strategy to RPA, identification and clarification of roles of the public authorities in RPA operations must be defined [30]. The situation picture can be improved by developing and expanding operational cooperation and mutual interaction between the authorities. Extensive cooperation between the authorities allows the development of real-time picture and situational awareness [31].

The research reported here attempted to generate new theory on the basis of existing theoretical constructs to meet organizational needs. As noted in the literature review, specific research aim is a relatively new one. Therefore, this study used a case study approach, which is generally recommended as a suitable research design for theory-building [12]. Design knowledge applies to people who have received formal education in that field [32]. It is required that researchers understand the implications of their research perspective, and act in ways that reflect that knowledge [12].

It should be noted that the development of a multi-government tactics and sharing of expertise in matters of safety and training increases the efficient use of joint resources. For complex tasks of planning, designing and coordination, based on multi-government functions, a real-time picture is essential [33].

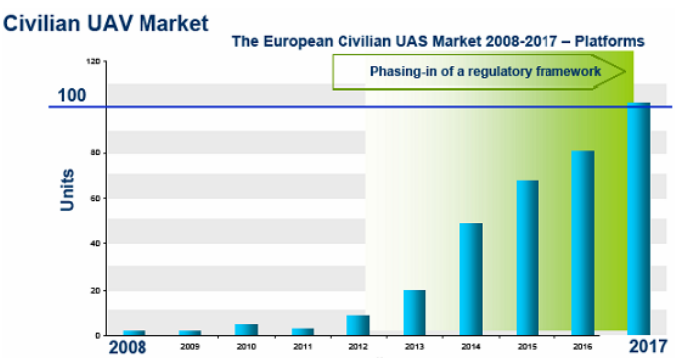
We believe that not enough attention has been paid to cooperation and networking between different authorities and experts concerning RPA Systems' use in public safety duties. The importance of networks and networking in today's world cannot be overstated. A smooth and seamless cooperation between different spheres of actors contributes to RPAS's implementation for public and private needs and for improving and speeding up the preparation and inception of legislation of RPAS.

It is important to create a situational picture for managing and monitoring major disasters and thus build an overview of activities in the field. The use of RPA in accident situations may guide rescue management to prevent additional damages to humans and property by observing the area of interest. RPA may observe large areas at a time and thus allow Law and Emergency Authorities (LEA) to concentrate their efforts on the most important functions [23].

Based on the results of this study, the market clearly has a huge economic promise for all RPAS MTOM classes and services utilizing them. When using RPAS such benefits may be achieved that cannot be achieved by other means. As a result, the social benefits are significant when using RPAS-enabled services. RPAS would significantly increase the number of the biggest priorities of safety, security and environmental issues.

The significant increase in the use of new air services is expected to be occurring in the near future as Fig. 4 shows.

FIGURE 4 CIVILIAN UAV MARKET, NEXT FIVE YEARS? [34]



These markets are a catalyst for the development of technology in many areas, which will have significant spin-off potential. RPAS joint use, both civilian and military, is a key condition for non-military government applications. RPAS may be applied by applications where the airplane's or helicopter's use is too expensive to perform a task or there is a risk for human life.

The European Commission's AIRBEAM project is one possibility to the EU level co-operation aimed at improving situational awareness by using opportunities of Remotely Piloted Aircraft Systems. In April 2011 was held the first official Finnish UAS -course. In that course, UAS related activities were generally divided into three sections; business, training and end users. This kind of course might be seen as the beginning for networking and collaboration of the above-mentioned parties.

UAS systems are a fast-growing form of aviation. Operations have started by the Military Forces and civilian markets are now waking up to the operation.

As pointed earlier; a good system regards the end user, and it is made in co-operation with the manufacturers and end-users. Increased public and private co-operation is needed. Legislation must be in line both with the international and national levels. RPA systems will be the business of future, and it has been said that the RPA systems can be equated with the early days of aviation. Research and development is in a key position at first step.

References

[1] Association of Finnish Defence and Aerospace Industries Aviation Group, Aviation Industry and Aviation Technology Program Criteria, 2010, pp. 6-8.
[2] European Commission. 2011. Strategy for unmanned aircraft systems in the European Union. Available: http://ec.europa.eu/
[3] M.E. Porter, S. Stern, National Innovative Capacity. The global competitiveness report. 2001. Available: http://www.isc.hbs.edu/
[4] European Commission. Seventh Framework Programme. Available: http://cordis.europa.eu/fp7/
[5] European Commission. 2012. Sixth Framework Programme. Available: http://ec.europa.eu/research/transport/projects/items/inoui_en.htm
[6] T. Tuohimaa, I. Tikanmäki and J. Rajamäki, Cooperation challenges to public safety organizations on the use of unmanned aircraft systems (UAS), International Journal of systems applications, engineering & development, Issue 5, Volume 5, 2011, pp. 610 – 617.
[7] Prime Minister's Office Publications. 2009. Finnish Security and Defense Policy 2009. ISBN 978-952-5807-31-8. 5.2.2009.
[8] Taitto et al. Pelastusopisto. Viranomaisyhteistyö – hyvät käytännöt. Pelastusopiston julkaisu 1/2007. ISBN 978-952-5515-37-4, 2007.
[9] T. Toivola, Verkostoituva yrittäjyys. Strategiana kumppanuus. Helsinki: Edita, 2006.
[10] R. Yin, Case Study Research. Design and Methods. Fourth Edition, London: SAGE Publications, 2009.
[11] K.M. Eisenhardt, Building Theories from Case Study Research. The Academy of Management Review, Oct 1989; 14, 4; ABI/INFORM Global, 1989, pp. 532 – 550.
[12] W.J. Orlikowski, and J.J. Baroudi, Studying information technology in organizations: Research approaches and assumptions. Information Systems Research, 1991, 2(1), pp. 1-28.
[13] P. Eriksson, and K. Koistinen, Monenlainen tapaustutkimus. Kuluttajatutkimuskeskus. Julkaisuja 4:2005. Kerava: Savion Kirjapaino, 2005..
[14] I. Koskinen, P. Alasuutari, and T. Peltonen, Laadulliset menetelmät kauppatieteissä. Jyväskylä: Gummerus Kirjapaino, 2005.
[15] J. Gerring, Case study research. Principles and practises. Cambridge: Cambridge University Press, 2007.
[16] L. Dubé, and G. Paré, Rigor in Information Systems Positivist Care Research: Current Practices, Trends and Recommendations. MIS Quarterly, (27) 4, 2003, pp. 597 – 635.
[17] ICAO (International Civil Aviation Organization). Ninth Edition 2006. Convention on International Civil Aviation. Doc 7300/9. Available: http://www.icao.int/icaonet/dcs/7300.html
[18] Eurocontrol. 2007. EUROCONTROL Specifications for the Use of Military Unmanned Aerial Vehicles as Operational Air Traffic Outside Segregated Airspace. Available: http://www.eurocontrol.int/
[19] ICAO (International Civil Aviation Organization). 2009. ICAO Training Course of Regional Officers. Available: http://www2.icao.int/
[20] ICAO (International Civil Aviation Organization). 2010. Workshop on the development of National Performance Framework for Air Navigation Systems, December 2010. Available: http://www.icao.int/
[21] CAA (UK Civil Aviation Authority). 2010. CAP 722. Unmanned Aircraft System Operations in UK Airspace – Guidance. Available: http://www.caa.co.uk/docs/33/CAP722.pdf
[22] L. Tuomi, and T. Sumkin Strategia arjessa: oivalluksia organisaation uudistajalle. WSOYpro. Helsinki, 2010.
[23] S. Määttä, and T. Ojala Tasapainoisen onnistumisen haaste. Johtaminen julkisella sektorilla ja balanced scorecard. Helsinki: Edita, 2000.
[24] The Finnish Funding Agency for Technology and Innovation (TEKES). 2009. Situation Awareness Seminar 27.8.2009, Situation Awareness – State of Art and Beyond –seminar.
[25] S. Helakorpi, Verkostot ja muuttuva asiantuntijuus. Kever 4/2005, 2005.
[26] H. Ruoslahti, R. Guinness, J. Viitanen, and J. Knuuttila, "Airborne Security Acquisition Using Micro Air Vehicles: Helping Public Safety Professionals Build Real-Time Situational Awareness, 2009.

[27] G. Vachtsevanos, and B. Ludington, Unmanned Aerial Vehicles: Challenges and Technologies for Improved Autonomy, 10th WSEAS international conference on systems, Vouliagmeni, Athens, Greece, July 10-12, 2006, pp. 56-63.
[28] M. Lundell, J. Tang, T. Hogan, and K. Nygård, An Agent-based Heterogeneous UAV Simulator Design, 5th WSEAS international conference on artificial intelligence, knowledge engineering and data bases, Madrid, Spain, February 15-17, 2006, pp. 453-457.
[29] A. Sanna, and B. Pralio, Simulation and Control of Mini UAVs, 5th WSEAS international conference on simulation, modeling and optimization, Corfu, Greece, August 17-19, 2005, pp. 129-135.
[30] I. Tikanmäki, and T. Tuohimaa, How real time picture and situational awareness can be improved by using Unmanned Aircraft Systems (UAS)?, 10th WSEAS international conference on communications, electrical & computer engineering, Playa Meloneras, Spain, Mar 2011, ISBN: 978-960-474-286-8, 2011, pp. 28-33.
[31] T. Tuohimaa, and I. Tikanmäki, The Strategic Management Challenges of Developing Unmanned Aerial Vehicles in Public Safety Organizations, 10th WSEAS international conference on communications, electrical & computer engineering, Playa Meloneras, Spain, Mar 2011, ISBN: 978-960-474-286-8, pp. 34-39.
[32] J.E. Van Aken, Management research based on the paradigm of design sciences: The quest for field-tested and grounded technological rules. *Journal of Management Studies*, 41(2), 2004, pp. 219-246.
[33] I. Tikanmäki, T. Tuohimaa and J. Rajamäki, How and why Unmanned Aircraft Vehicles can improve Real-time awareness?, International Journal of circuits, systems and signal processing, Issue 5, Volume 5, 2011, pp. 469 – 477.
[34] Frost & Sullivan, A study of potential European markets for civil and commercial UAVs, 2008-2017. 2008. Available: http://www.frost.com